Peculiarities of functioning of studied systems, as link between their physical-and-chemical properties and their consumption properties, researched by means of the intensive research method and method of the characteristic transformations

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Peculiarities of processes that go inside an electrochemical battery under or after some influence on the battery are conditioned by relevant physical-and-chemical properties of the battery's inner medium. To more comprehensively study properties of the battery's inner medium that are connected with some type of influence on the battery, we can study peculiarities of processes that go inside the electrochemical battery for different values of a relevant parameter of the influence. We can consider response functions of a studied system at different values of a relevant parameter of an influence as one united response function of the studied system for this type of influence, and we can research processes in the system and relevant properties of the researched system studying functional peculiarities of this function. Such approach puts in equal position both time of evolution of a studied system under an influence and an influence parameter and is convenient to study their interrelation. The recent research / 1 / of the properties of lithium batteries small-current discharges and recovery after them showed effectiveness of such approach.

In the framework of the mentioned above approach, we can consider different research situations. In particular, we can study a united response function for a relatively broad region of influence parameter values but for a short time of their action. Such study is interesting, for example, to predict properties of researched systems or forecast these properties at a periodical check up at a long not continuous functioning.

The intensive research method / 2 / gives us possibility to get a united response function for a studied system relatively quickly and for different schemes of data acquisition. In the method, a united response function of a studied system to an influence is measured both during short-time influence actions and during recovery pauses between them. The actions are different in an influence "strength" and follow in the order of increase of the "strength". When we are interested in a study of general properties of some type of systems, we can research an ensemble of identical objects and act on them simultaneously by different-in-"strength" actions. We consider here possibilities of the intensive research method connected with application of the characteristic functions / 3, 4 / and the multi-dimensional diagrams / 5 / to reach goals discussed above.

The characteristic functions are convenient to find analytical functional expressions of experimental dependencies of different quantities which characterize functioning of studied systems: the flat sections of the characteristic functions speak about the corresponding functional behavior of corresponding quantities in the corresponding sections. As we can see, the characteristic transformation method is visual and independent on the place in the studied dependence argument interval where expected functional behavior is. And what is more, for the goals mentioned above, we can use only some preferable and simple characteristic transformations and characteristic functions like dimensionless characteristic index of susceptibility of studied quantities to changes of influence conditions / 3, 4 /.

If we get analytical functional expressions of experimental dependencies of relevant quantities, we can hope that this knowledge will help us to understand the nature of a studied phenomenon and prompt its theoretical description, and values of the quantities' characteristic functions in the flat sections, the length of these sections, and their position will be convenient for comparison of properties of studied systems.

One of the main tasks of processing of experimental research data is to diminish the number of experimental data that can characterize a studied system. As it is clear from what was mentioned above, information connected with the flat and quasi-flat sections of the relevant quantities' and characteristic functions' dependencies, can be useful to characterize studied systems and characterize difference in their consumption properties.

However, these functional signs are not only functional features that can be used to characterize consumption properties of researched systems in the framework of the discussed methods. The multi-dimensional diagrams / 5 / of the characteristic functions contain comprehensive information about peculiarities of functional behavior of processes going in a studied system for a broad region of discharge currents. Some of them, like the diagrams of dimensionless index of susceptibility of studied quantities to changes of influence conditions, are informative and visual, and in a sense, they can be used as a technical passport of system operation. The dimensionless index of irreversibility of changes in a studied system under an influence, k_{irrev}, also can prove to be a useful function for these goals, ($k_{irrev}=(\Delta Hinfl - \Delta Hrec)/\Delta Hinfl$, where ΔH is changes of a united response function during an influence and following recovery for an equal time t).

If functioning of a studied system can't be interrupted and researched at different conditions of operation, we can't apply the intensive research method. Even if so, we can still research this system by means of the characteristic transformations method / 3, 4 /. In any case, use of the characteristic functions is preferable than use of simple derivatives because the characteristic functions are more informative, and their dimensions are more convenient than dimensions of simple derivatives.

Here, we present the results on some quantities and quantities' characteristic functions that describe discharge process of the lithium batteries. The polarization H of the lithium battery, its inner resistance r, the discharge current I through the battery and the quantity HI are among the researched quantities. The experimental data have been obtained by the intensive research method / 2 /. The VARTA CR 2032, CR 2016 GP, ENERGIZER CR 2025, BR 2020, and BR 2325 lithium batteries were used at the study. The presented results are accented on discussed above points.

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